Dear editors and experts:

First of all, on behalf of all the authors of the paper "Cauda equina nerve calcification: A case report" (NO.80543), I would like to express my sincere gratitude to you for your valuable suggestions on the revision of this paper. I have carefully revised the format and content of this manuscript according to the comments of editors and peer review experts. Since I am not a native speaker of English, I entrusted a professional organization to polish the language of the whole manuscript. In this modification note, I will mark the experts' comments and questions in blue font, and mark my replies and modifications in red font. Specific amendments and responses to expert opinions are as follows:

1、Add "Post-traumatic Cauda equina calcification" to the title and keywords, because the basis for the development of the disease is described in the anamnesis.

Answer: I think the expert's opinion is very constructive. I have cha nged the title of the article to "Post-traumatic Cauda equina calcification ". The patient had a history of violent trauma 35 years ago and underw ent emergency surgery. In the recent imaging data of the patient, it can also be clearly observed that the patient's spine has undergone huge p athological changes due to violent trauma. In consideration of the patien t's trauma history, existing symptoms, imaging data and possible mecha nism of nerve calcification, "Post-traumatic Cauda equina calcification" sh ould be added to the title and key words. Only in this way can the rel ationship between trauma and cauda equina nerve calcification be reflect ed, and the title and content of the article be closely linked. This can n ot only reflect the cause of cauda equina nerve calcification, but also he lp to clarify the mechanism of cauda equina nerve calcification. Changin g the title of the article to "Post-traumatic Cauda equina nerve calcification on" can make the whole article more coherent and have more clinical re ference significance.

2、There are repeated sentences "Nerve calcification is usually found in the cerebral and dental nerves, and the cause is usually degenerativ e disease, infection, etc[3]. Nerve calcification is usually found in the cer ebral and dental nerves, and the cause is usually degenerative disease, i nfection, etc[3]. The cause is usually degeneration, infection, etc" and "It has also been suggested that IBCG is associated with carbonic anhydra se II deficiency. The IBCG has also been suggested to be associated with h carbonic anhydrase II deficiency[12][13]".

Answer: Thank you for your correction. This low-level error was ca used by my careless writing. I have completely corrected such errors in the full text and deleted the duplicate statements.

3、In the pathogenesis of the development of calcification, the arach noiditis present during the injury has not been discussed, because the s earch query in pubmed also reflects the issue of Cauda equina calcificati on from this perspective (https://pubmed.ncbi.nlm.nih.gov/?term=Cauda% 20equina%20calcification)

Answer: Thank the experts for their additional comments and refere nces. Since the calcification of the cauda equina nerve in this patient is secondary to traumatic stress, it is very necessary to discuss the arachno iditis after trauma. We searched databases such as PubMed, Web of Scie nce and CNKI with the keywords of "cauda equina nerve calcification" and "arachnoiditis". We found about 25 articles related to cauda equina nerve calcification and arachnoiditis, and thought and extracted valuable papers. Finally, we added the content to the paper. We have added th e following:

Since cauda equina nerve calcification in this patient is secondary to trauma stress, it is necessary to discuss arachnoiditis during injury. The

re are also some literatures that study the problems related to cauda eq uina nerve calcification from this perspective. In 1999, I. G. Bilgen repor ted a case of cauda equina syndrome caused by ankylosing spondylitis, a patient with adhesive arachnoiditis. CT data of the patient showed sig ns of dural calcification. His MRI data showed that the cauda equina ha d adhesions with the dorsal arachnoid membrane. They believe that ara chnoiditis is responsible for cauda equina syndrome and curvilinear dur al calcification^[17]. In 2021, Dr. Anna Brunner et al. introduced a case of intradural calcification caused by chronic adhesive arachnoiditis and perf ormed a dural incision exploration, and found nerve calcification structu res in the dural sac. Anna Brunner et al. believed that the main cause of calcification was the inflammation of arachnoid membrane. Arachnoid inflammation leads to excessive proliferation of arachnoid cells, which l eads to excessive production of collagen tissue and rapid formation of i ntradural scars. Subsequently, osteoblasts are generated, leading to progr essive intradural ossification. However, the pathogenesis of ossifying ara chnoiditis has not been completely clarified ^{備误}. Abad Cherif El A sri et al. reported a rare case of post-traumatic Arachnoiditis ossifi cans of the cauda equina nerve. Abad Cherif El Asri et al. clearly proposed t hat trauma, surgery, infection and subarachnoid hemorrhage are the m ain causes of post traumatic arachnoiditis ossifi cans of the cauda equin a nerve 错误!未找到引用源。错误!未找到引用源。

4. For addition, it is possible to add a pathogenesis scheme describing the mechanism of Cauda equina calcification

Answer: In the original text, we did not systematically discuss the s pecific mechanism of cauda equina nerve calcification after trauma, whic h made the paper empty and without scientific value. Therefore, we car efully supplemented the relevant mechanism of cauda equina nerve calci fication after trauma according to expert opinions, and speculated and a nalyzed the cause of cauda equina nerve calcification in this patient. Th e mechanism of cauda equina nerve calcification after trauma is as follo ws:

4.1、However, pathological calcification of cauda equina nerve is ext remely rare.We speculate that cauda equina nerve calcification in this pa tient may be secondary to acute trauma and surgical scar, thus stimulati ng local lesions. In addition, lumbar spinal stenosis, lumbar disc herniati on, spinal tumors and spinal infection are also possible causes of cauda equina nerve calcification ^{(新興:未找到引用編.}.

4.2. The cauda equina nerve is easy to be damaged (for example, t he free nucleus pulposus and epidural hematoma will cause the cauda equina nerve to be compressed), because the cauda equina nerve has no protective sheath of connective tissue and is particularly sensitive to co mpression. The recovery after peripheral nerve injury is very slow, whic h may be due to the lack of blood supply. The nutrition of cauda equi na nerve also comes from cerebrospinal fluid and blood, and the recove ry of cauda equina nerve after injury is slower than that of peripheral nerve. Therefore, we can boldly speculate that the mechanism of cauda equina nerve suffer from mechanical compression or tissue necrosis, whi ch affects the blood supply of cauda equina nerve. Due to long-term po or blood supply, nerve dehydration and poor calcium and phosphorus metabolism lead to calcium salt deposition, which eventually leads to ca uda equina nerve calcification[7,8].

4.3、It is worth noting here that the ESR, C-reactive protein, RF and ANA of the cases reported by us are higher than the normal values. T his is consistent with the study of IBCG.

4.4. The benign tumor of the cauda equina nerve may also lead to the calcification of the cauda equina nerve. We call this benign tumor t he neurilemmoma of the cauda equina nerve. spinal cord neurilemmoma

often occur in the spinal cord nerve roots, but only a few occur in the cauda equina nerve. Because the neurilemmoma of the cauda equina n erve has good activity and broad intradural space, it usually has no ob vious pain symptoms. The report of neurilemmoma calcification is extre mely rare. In 2012, Dr. Seung Jae Hyun and others from South Korea r eported that a 21 year old patient with dystrophic neurilemmoma of ca uda equina had calcification, and the neurilemmoma was completely re moved by surgery. However, this report does not explain the relationshi p between trauma and calcification of cauda equina neurilemmoma^[12]. P araganglioma is a neuroendocrine tumor located outside the adrenal gla nd. Paragangliomas originating from filum terminale or cauda equina ne rve are rare (accounting for 1% of all paragangliomas and 3-4% of all t umors in the lower lumbar spine). Calcification of cauda equina nerve p araganglioma is very rare. It is noteworthy that Professor M Vural once reported cauda equina paraganglioma with obvious calcification charact eristics, but did not clarify its cause and pathogenesis^[13]. Professor J Rot é s Querol once reported a case of cauda equina syndrome caused by ankylosing spondylitis, which caused calcification of lumbosacral mening es. However, the CT images of the cases reported by Professor J Rot é s Querol showed perispinal calcification rather than central calcification^[1] ^{4]}. Intradural lumbar disc herniation is another important cause of intras pinal calcification and even cauda equina nerve calcification. Intradural 1 umbar disc herniation means that the free nucleus pulposus punctures t he fibrous ring, posterior longitudinal ligament and dura mater, and dir ectly compresses the spinal cord or nerve after entering the subdural ca vity, resulting in acute spinal cord or cauda equina nerve injury. Intrad ural disc herniation is a rare type of disc herniation, with a incidence r ate of 0.26% - 0.3%. The most common location of the disease was the lumbar spine, accounting for 92%^[15]. Surgical exploration is the only sta ndard for the diagnosis of intradural lumbar disc herniation. Although i t is difficult to make a definite diagnosis of intradural lumbar disc hern iation through imaging and symptoms, some special signal signs shown by imaging data can well indicate the existence of free intradural nucle us pulposus. For example, the Y sign refers to the prominent nucleus p ulposus separating the dura and arachnoid membranes into two lines in a "Y" shape. Over time, the free nucleus pulposus entering the dura wi ll directly compress the cauda equina nerve and calcification will occur to some extent ^{##,1*##JIJH##}. We speculate that the calcification of the free nucleus pulposus will probably cause the calcification of the cauda equi na nerve compressed by it.

5. Make references to sources of literature in the text of the manusc ript according to the requirements of the journal.

Answer: The citation of references can reflect the rigorous academic spirit of the author and is an important basis for evaluating the academ ic level of the paper. References are the relevant literature information r esources cited for writing papers, the carrier of academic inheritance an d academic ethics, and also reflect the context of academic development. Therefore, references are an important part of academic papers, and m ust also appear in the paper. I have quoted the source of literature in t he manuscript text according to the requirements of the journal and in accordance with the principles of authority, timeliness, relevance, accurac y and objectivity of literature citation. The details are as follows:

[1] Joshi A, Chitale N, Phansopkar P. The Impact of Physical Thera py Rehabilitation on Pain and Function in a Patient With Cauda Equina Syndrome. Cureus. 2022 Aug 18;14(8):e28131. [PMID: 36134093 DOI: 10. 7759/cureus.28131]

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6. The sequential order of references at discussion should be correct ed...for example, reference number 4 was followed by number 10 and re ference number 8 was followed by number 14....etc.

Answer: Thank you very much for your reminding. Accurate refere nce is an important embodiment of the paper format. I have corrected a ll the wrong citation order of the reference, as follows:

INTRODUCTION : Post-traumatic cauda equina nerve calcification r efers to the deposition of calcium in ten pairs of lumbosacral nerve root s below the conus medullaris, resulting in various clinical symptoms^[1]. The cauda equina nerve is the bridge between the spinal cord and the peripheral nerve, connecting the pseudounipolar neurons of the dorsal r oot ganglion and the spinal cord neurons. Because of its special anatomi cal structure (only a layer of nerve inner membrane, lack of correspondi ng protective tissue), it is vulnerable to mechanical injury. The nutrition of cauda equina nerve comes from cerebrospinal fluid and blood, and t here is a relatively anemia area in the anastomosis between the spinal a

rtery and the root artery supplying the cauda equina nerve, so the caud a equina nerve is more prone to decompensation due to mechanical co mpression ^(HK)/^(KK). Post-traumatic cauda equina nerve calcification is e xtremely rare clinically, and its etiology, pathogenesis, treatment, and pr ognosis are unclear. No studies or reports on Post-traumatic cauda equi na nerve calcification have been inquired, and a case of Post-traumatic c auda equina nerve calcification is reported here for reference.

DISCUSSION:

Nerve calcification usually occurs in the cranial nerve and the dental ne rve. It is generally accepted that nerve calcification is divided into two main types: physiological and pathological calcification. Physiological cal cification is due to the natural formation of calcified spots on the nerve with age. Pathological calcification is caused by degenerative diseases, parasitic infections, ischemic necrosis of the surrounding tissue of the ne rve, oxidative stress, and apoptosis ^{備误,未找到引用源。}. However, pathological calc ification of cauda equina nerve is extremely rare.We speculate that caud a equina nerve calcification in this patient may be secondary to acute tr auma and surgical scar, thus stimulating local lesions. In addition, lumb ar spinal stenosis, lumbar disc herniation, spinal tumors and spinal infec tion are also possible causes of cauda equina nerve calcification #Registration *. L2-5, S1-5 and the 10 pairs of nerve roots emanating from their caud al segments together form the cauda equine nerve. The cauda equina ner ve, in the usual sense, is the nerve root below L2 that innervates the p elvis as well as the perineum.It is a very important nerve in the human hanges, it will lead to dysfunction of sensory nerve, motor nerve, auton omic nerve, etc., thus causing other body dysfunction. as opposed to th e cauda equina nerve calcification, Cauda equina injury is relatively com mon in clinical practice $^{\text{fl},\text{ft},\text{ft})}$. The clinical symptoms of cauda equin a compression were first reported by Verbiest in 1949 and were named

Cauda Equine Syndrome (CES). The clinical symptoms of cauda equina n erve injury mainly include Low back pain, numbness of one or both lo wer limbs, weakness of lower limbs, weakness or disappearance of tend on reflex, sensory abnormalities in the sellar region, sphincter dysfunction, urinary incontinence, and sexual dysfunction. The cauda equina nerve i s easy to be damaged (for example, the free nucleus pulposus and epid ural hematoma will cause the cauda equina nerve to be compressed), be cause the cauda equina nerve has no protective sheath of connective tiss ue and is particularly sensitive to compression. The recovery after perip heral nerve injury is very slow, which may be due to the lack of blood supply. The nutrition of cauda equina nerve also comes from cerebrosp inal fluid and blood, and the recovery of cauda equina nerve after injur y is slower than that of peripheral nerve. Therefore, we can boldly spec ulate that the mechanism of cauda equina nerve calcification may be tha t the surrounding tissues of cauda equina nerve suffer from mechanical compression or tissue necrosis, which affects the blood supply of cauda equina nerve. Due to long-term poor blood supply, nerve dehydration a nd poor calcium and phosphorus metabolism lead to calcium salt depos ition, which eventually leads to cauda equina nerve calcification^{[7][8]}.

There are many reports on Idiopathic Basal Ganglia Calcification (IB GC) in the existing literature, but the specific cause is still unclear, and scholars believe that it is related to the following factors: (1) Genetic stu dies show that IBCG patients have autosomal recessive or dominant inh eritance. (2) Vitrification during atherosclerosis can lead to calcium depo sition, so some scholars believe that local calcium accumulation is relate d to changes in vascular osmotic pressure. (3) The abnormal level metab olism of iron and calcium phosphate, especially the decrease of serum f erritin level and iron binding capacity, will also lead to IBGC. (4) Exoge nous toxic substances continuously stimulate and activate glutamate rece ptor, thus producing neurotoxin effect, leading to calcium ion deposition.

(5) It has been reported in the literature that during brain biopsy of p atients with IBGC, there are immune inflammatory cells infiltrating arou nd calcification points and ESR is accelerated, while C-reactive protein, r heumatoid factor (RF) and antinuclear antibody (ANA) are significantly i ncreased. So the occurrence of IBGC is also related to the immune syste m. It is worth noting here that the ESR, C-reactive protein, RF and AN A of the cases reported by us are higher than the normal values. This i s consistent with the study of IBCG. (6)The IBCG has also been suggest ed to be associated with carbonic anhydrase II deficiency. Regrettably, t he epidemiological characteristics and specific treatment methods of basa 1 ganglia calcification have not been studied^{[9],[10],[11]}.

The benign tumor of the cauda equina nerve may also lead to the calcification of the cauda equina nerve. We call this benign tumor the n eurilemmoma of the cauda equina nerve. spinal cord neurilemmoma ofte n occur in the spinal cord nerve roots, but only a few occur in the cau da equina nerve. Because the neurilemmoma of the cauda equina nerve has good activity and broad intradural space, it usually has no obvious pain symptoms. The report of neurilemmoma calcification is extremely r are. In 2012, Dr. Seung Jae Hyun and others from South Korea reported that a 21 year old patient with dystrophic neurilemmoma of cauda equ ina had calcification, and the neurilemmoma was completely removed b y surgery. However, this report does not explain the relationship betwee n trauma and calcification of cauda equina neurilemmoma^[12]. Paragangli oma is a neuroendocrine tumor located outside the adrenal gland. Parag angliomas originating from filum terminale or cauda equina nerve are r are (accounting for 1% of all paragangliomas and 3-4% of all tumors in the lower lumbar spine). Calcification of cauda equina nerve paragangli oma is very rare. It is noteworthy that Professor M Vural once reported cauda equina paraganglioma with obvious calcification characteristics, b ut did not clarify its cause and pathogenesis^[13]. Professor J Rot é s Que

rol once reported a case of cauda equina syndrome caused by ankylosin g spondylitis, which caused calcification of lumbosacral meninges. Howe ver, the CT images of the cases reported by Professor J Rot é s Querol showed perispinal calcification rather than central calcification^[14]. Intradu ral lumbar disc herniation is another important cause of intraspinal calci fication and even cauda equina nerve calcification. Intradural lumbar dis c herniation means that the free nucleus pulposus punctures the fibrous ring, posterior longitudinal ligament and dura mater, and directly com presses the spinal cord or nerve after entering the subdural cavity, resul ting in acute spinal cord or cauda equina nerve injury. Intradural disc h erniation is a rare type of disc herniation, with a incidence rate of 0.26% - 0.3%. The most common location of the disease was the lumbar spine, accounting for 92%^[15]. Surgical exploration is the only standard for the diagnosis of intradural lumbar disc herniation. Although it is difficult t o make a definite diagnosis of intradural lumbar disc herniation throug h imaging and symptoms, some special signal signs shown by imaging data can well indicate the existence of free intradural nucleus pulposus. For example, the Y sign refers to the prominent nucleus pulposus separ ating the dura and arachnoid membranes into two lines in a "Y" shape. Over time, the free nucleus pulposus entering the dura will directly co mpress the cauda equina nerve and calcification will occur to some exte nt $\frac{\#_{\mathbb{R}}, \#_{\mathbb{R}}, \#_{\mathbb{R}}}{\#_{\mathbb{R}}, \#_{\mathbb{R}}}$. We speculate that the calcification of the free nucleus pulp osus will probably cause the calcification of the cauda equina nerve co mpressed by it.

Since cauda equina nerve calcification in this patient is secondary to trauma stress, it is necessary to discuss arachnoiditis during injury. The re are also some literatures that study the problems related to cauda eq uina nerve calcification from this perspective. In 1999, I. G. Bilgen repor ted a case of cauda equina syndrome caused by ankylosing spondylitis, a patient with adhesive arachnoiditis. CT data of the patient showed sig

ns of dural calcification. His MRI data showed that the cauda equina ha d adhesions with the dorsal arachnoid membrane. They believe that arac hnoiditis is responsible for cauda equina syndrome and curvilinear dural calcification^[17]. In 2021, Dr. Anna Brunner et al. introduced a case of in tradural calcification caused by chronic adhesive arachnoiditis and perfor med a dural incision exploration, and found nerve calcification structure s in the dural sac. Anna Brunner et al. believed that the main cause of calcification was the inflammation of arachnoid membrane. Arachnoid in flammation leads to excessive proliferation of arachnoid cells, which lea ds to excessive production of collagen tissue and rapid formation of intr adural scars. Subsequently, osteoblasts are generated, leading to progress ive intradural ossification. However, the pathogenesis of ossifying arachn oiditis has not been completely clarified ^{備误」未找到引用源。}. Abad Cherif El Asri et al. reported a rare case of post-traumatic Arachnoiditis ossifi cans of the cauda equina nerve. Abad Cherif El Asri et al. clearly proposed that trauma, surgery, infection and subarachnoid hemorrhage are the main causes of post traumatic arachnoiditis ossifi cans of the cauda equina n erve ^{错误}!未找到引用源。错误_!未找到引用源。

Since cases of Post-traumatic cauda equina nerve calcification are ex tremely rare in clinical practice, our research on this disease has not bee n carried out and the literature that we have been able to study is very scarce. Therefore, it is necessary that we carry out studies on the etiolo gy, mechanisms, treatment and prognosis of this disease.

Reference.

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- [2] Fukatsu S, Ogihara S, Imada H, Ikemune S, Tamaru JI, Saita K. Chr onic spontaneous epidural hematoma in the lumbar spine with ca

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- [7] Rascón-Ramírez FJ. Spinal cord stimulation and cauda equina syndro me: Could it be a valid option? A report of two cases. Neurociru gia (Astur : Engl Ed). 2022 Mar-Apr;33(2):90-94. [PMID: 35248303 DOI: 10.1016/j.neucie.2020.12.002]
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In addition to the parts required by experts, I have carefully revise d the whole paper in terms of format, language, content and scientificit y, so as to strive to meet the publication standards of your journal. Plea se refer to the revised manuscript for specific contents. Here, on behalf of all the authors of the paper "Cauda equina nerve calcification: A case report" (NO.80543), I would like to thank you again for your hard wor k!

I wish you good health and all the best.

Yours Sincerely Qiang Deng